PATENT ABSTRACTS OF JAPAN

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(54) FLUID BEARING LIQUID LEVEL INSPECTION METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To execute inspection of a liquid level height of a lubricant inside a fluid bearing device having a radial-side hydrodynamic pressure generation groove without dismantling the device.
SOLUTION: A neutron beam 12 is irradiated to a fluid bearing device where parts 4D,

4E having apertures larger than a bearing aperture are formed respectively on both ends of the bearing aperture, and the transmission or absorptance state of the neutron beam 12 is observed. Hereby, existence and a liquid level height of a lubricant 10 existing inside the fluid bearing device can be inspected without dismantling the fluid bearing device.

CLAIMS

[Claim(s)]

[Claim 1] Have the sleeve inserted in the shaft free [rotation], and even if there is little periphery side of the aforementioned shaft or aforementioned sleeve inner skin, it has a radial side dynamic pressure generating slot in either. As opposed to the liquid bearing equipment with which the crevice prepared the adult portion in the ends of the bearing clearance formed between the periphery side of the aforementioned shaft, and the inner skin of a sleeve while lubricant is held in the aforementioned radial side dynamic pressure generating slot from the aforementioned bearing clearance, respectively The liquid bearing oil-level inspection method of irradiating a neutron beam and inspecting the existence and the oil-level height of the aforementioned lubricant which exist in the interior of the aforementioned liquid bearing equipment from transparency of the aforementioned neutron beam, and an absorption coefficient.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the liquid bearing oil-level inspection method of inspecting the existence and the oil-level height of lubricant inside bearing, in the liquid bearing equipment used for a slewing gear etc.

[0002]

[Description of the Prior Art] An example of the conventional liquid bearing oil-level inspection method is explained referring to a drawing below. Drawing 4 is the cross section of liquid bearing equipment.

[0003] 41 is the base, 42 is a shaft, one end is fixed to the base 41, and the flange 43 is being fixed to the other end. The hub 44 which has sleeve 44A is attached in the periphery of a shaft 42 free [rotation], and the radial side dynamic pressure generating slots 44B and 44C are established in the periphery of a shaft 42, or the inner circumference of sleeve 44A. Moreover, the flange 43 fixed to the other end of a shaft 42 is countered and approached, and the thrust board 47 is combined with the hub 44. Having thrust side dynamic pressure generating slot 47A in the flange 43 of the thrust board 47, and the position which counters, these radials side dynamic pressure generating slots 44B and 44C and thrust side dynamic pressure generating slot 47A are full of lubricant 50. The motor stator 45 is fixed to the base 41, and the motor rotor 46 is being fixed to the hub 44. The hub 44 is the configuration where Disks 48A and 48B and spacer 49A can be attached.

[0004] About the liquid bearing equipment constituted as mentioned above, the operation is explained below. First, energization is carried out to the motor stator 45, and if rotating magnetic field are generated, the motor rotor 46 will carry out the rotation drive of the hub 44. At this time, both the hubs 44 are rotated with the thrust board 47, Disks 48A and 48B, and spacer 49A. At this time, the radial side dynamic pressure generating slots 44B and 44C and thrust side dynamic pressure generating slot 47A carry out the pumping of the lubricant 50, respectively, a pressure is generated, and a hub 44 surfaces and performs non-contact rotation.

[0005] In the above composition, although lubricant 50 was poured into the interior of the liquid bearing equipment which consists of a metal shaft and a metal sleeve as shown in drawing 4 , it was not able to see from the outside whether the amount of lubricant 50 would be proper.

[0006] Here, by producing lubricous pieces, such as an oil film piece, when the amounts of lubricant run short, seizure might be started, and when the amount of lubricant was

excessive, surplus lubricant might flow out and the circumference might be soiled.

[0007] Then, an example of the inspecting [visually] method currently performed conventionally is shown in drawing 5 as an alternative plan of the above-mentioned symptom.

[0008] drawing 5 changes the material of the hub 44 in drawing 4 , and sleeve 44A into a transparent material, and is transparent -- it is referred to as a hub 54 and transparent sleeve 54A

[0009] About the above conventional liquid bearing oil-level inspection methods, the detail is explained below. First, the principle of operation of liquid bearing equipment is the same as the case of composition of being shown in aforementioned drawing 4 . However, in the composition shown in drawing 5 , since the hub 54 and sleeve 54A which are a rotating part were constituted from a transparent material, the lubricant 50 colored the crevice between sleeve 54A and a shaft 42 was poured in, and visual observation of the oil-level height of the excess and deficiency of lubricant 50 or lubricant was carried out from the outside.

[0010]

[Problem(s) to be Solved by the Invention] However, by the above conventional inspection methods, since it was experimenting in model with material of a different kind, such as a transparent acrylic, it was not the same as that of actual liquid bearing equipment in respect of the lubricant 50 colored the configuration of the process-tolerance change side of sleeve 54A by temperature effects, a radial side, and the thrust side dynamic pressure generating slots 44B, 44C, and 47A, and checking, and a proper inspection result was not obtained.

[0011] Therefore, it was a technical problem to offer the method of inspecting the oil-level height of the excess and deficiency of the lubricant inside a bearing or lubricant, without changing the composition of bearing.

[0012]

[Means for Solving the Problem] In order to solve the above-mentioned trouble, the liquid bearing oil-level inspection method of this invention While it has the sleeve inserted in the shaft free [rotation], it has a radial side dynamic pressure generating slot in either even if there is little periphery side of the aforementioned shaft or aforementioned sleeve inner skin, and lubricant is held in the aforementioned radial side dynamic pressure generating slot As opposed to the liquid bearing equipment with which the crevice prepared the adult portion in the ends of the bearing clearance formed between the periphery side of the aforementioned shaft, and the inner skin of a sleeve from the aforementioned bearing clearance, respectively A neutron beam is irradiated

and the existence and the oil-level height of the aforementioned lubricant which exist in the interior of the aforementioned liquid bearing equipment are inspected from transparency of the aforementioned neutron beam, and an absorption coefficient.

[0013] this invention can be inspected by the above-mentioned composition, without decomposing the interior of liquid bearing equipment for the oil level of the lubricant inside liquid bearing equipment.

[0014]

[Embodiments of the Invention] The liquid bearing oil-level inspection method in the gestalt of 1 operation of this invention is explained below, referring to drawing 1 - drawing 3 .

[0015] Drawing 1 irradiates a neutron beam at liquid bearing equipment, and shows the composition which photos a transmission image with image pck-up equipment. Although a neutron beam makes it generate for example, from neutron-radiography-test equipment (not shown), explanation of neutron-radiography-test equipment itself is omitted.

[0016] First, the fixed shaft 2 is being fixed to the base 1 in the end about liquid bearing equipment. The hub 4 for fixing Disks 8A and 8B and spacer 9A to the fixed shaft 2 is united with sleeve 4A, and is inserted in the fixed shaft 2 free [rotation]. The abbreviation ring-like flange 3 is fixed to the upper-limit close-attendants side of the fixed shaft 2, and this flange 3 is contained by the crevice of a hub 4. Moreover, a flange 3 is countered and approached and the thrust board 7 is combined with the hub 4. At least 2 sets, for example, a herringbone configuration, of radial side dynamic pressure generating slots 4B and 4C are established in either the periphery side of the fixed shaft 2, or the inner skin of sleeve 4A, thrust side dynamic pressure generating slot 7A is prepared in either of the fields where the end face and the thrust board 7 of a flange 3 counter mutually, and the radial side dynamic pressure generating slots 4B and 4C and thrust side dynamic pressure generating slot 7A are lubricated with lubricant 10. Moreover, at least at one end of the radial side dynamic pressure generating slots 4B and 4C, it has crevice voluminousness 4D shown in drawing 3 , and 4E, and the motor rotor 6 is fixed to a hub 4, and the motor stator 5 is being fixed to the base 1.

[0017] The operation is explained about the liquid bearing equipment constituted as mentioned above. In drawing 1 , if it is energized by the motor stator 5 and rotating magnetic field are generated, the motor rotor 6 will carry out the rotation drive of the hub 4. At this time, a hub 4 is rotated with the thrust board 7. The radial side dynamic pressure generating slots 4B and 4C and thrust side dynamic pressure generating slot 7A carry out the pumping of the lubricant 10, respectively, generate a pressure, surface

the thrust board 7 and sleeve 4A, and make non-contact rotation perform at this time. At this time, the lubricant 10 radial side dynamic pressure generating slot 4B and near the 4C is supplied to the radial side dynamic pressure generating slot 4B and 4C side by the pump force produced by rotation. Moreover, lubricant 10 remains in the crevice between fixed shaft 2 periphery and sleeve 4A inner skin and crevice voluminousness 4D, and 4E with surface tension during a halt.

[0018] Moreover, when lubricant 10 stops fully spreading during rotation in the radial side dynamic pressure generating slots 4B and 4C, it has crevice voluminousness 4D, and 4E has the function as oil ****, and the radial side dynamic pressure generating slots 4B and 4C are supplemented with lubricant 10 from crevice voluminousness 4D and 4E.

[0019] A cross-section view view [in / x-x' of drawing 1 / in drawing 2] and drawing 3 express typically the lubricant 10 by which it is placed between the crevices between sleeve 4A and a shaft 2.

[0020] The point of the inspection method is as being shown in the following ** - **. That is, a neutron beam 12 is irradiated with neutron-radiography-test equipment, and it is made to penetrate to ** liquid bearing equipment. ** About the neutron beam which penetrates the interior of liquid bearing equipment, respectively peculiar absorption and a transparency state arise by the difference in the element which constitutes lubricant 10, sleeve 4A, the fixed shaft 2, etc. ** Take a photograph with image pck-up equipments, such as a photographic film or an image processing, in the transmission image by the neutron beam 12, and the oil-level height of lubricant etc. inspects the situation of internal lubricant by the difference in a transparency state. ** When the oil level of lubricant 10 is in crevice voluminousness 4D and 4E in the above-mentioned **, since the radial thickness of lubricant 10 is larger than other portions, it is easy to carry out detection of lubricant, and, moreover, an oil-level position becomes judgment of being proper.

[0021] In addition, although the radial side dynamic pressure generating slots 4B and 4C explained the case where it formed in the inner circumference of sleeve 4A, you may form them in the periphery side of the fixed shaft 2.

[0022] Moreover, even if sleeve 4A and a hub 4 are really [perfect] which consists of a dies casting component, a press component, etc. even if it is another member objects, they are the same.

[0023] As mentioned above, according to this operation form, for example, a neutron beam is irradiated to the liquid-bearing equipment which prepared the portion of crevice size in the ends of a bearing clearance, respectively using a neutron-radiography-test

method, and the situation inside bearing, such as oil-level height of lubricant, can be inspected by inspecting the existence and the oil-level height of the aforementioned lubricant which exist in the interior of the aforementioned liquid bearing equipment from transparency of the aforementioned neutron beam, and an absorption coefficient, without decomposing the interior of liquid bearing equipment.

[0024]

[Effect of the Invention] As mentioned above, since its radial thickness of lubricant is larger than other portions, without decomposing the interior of liquid bearing equipment when the oil level of lubricant is in crevice voluminousness, while this invention can inspect the excess and deficiency of the lubricant inside bearing, and the oil-level height of lubricant, it will be easy to carry out detection of lubricant, and it can be judged easily that an oil-level position is proper.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The cross section showing the whole liquid bearing oil-level inspection method composition of 1 operation gestalt of this invention

[Drawing 2] The x-x' cross-section view view of the liquid bearing equipment shown in drawing 1

[Drawing 3] The cross section explaining the important section of the oil-level inspection method of the liquid bearing equipment shown in drawing 1

[Drawing 4] Drawing of longitudinal section of liquid bearing equipment

[Drawing 5] Drawing of longitudinal section explaining the conventional liquid bearing oil-level inspection method

[Description of Notations]

2 Fixed Shaft

4A Sleeve

4B, 4C Radial side dynamic pressure generating slot

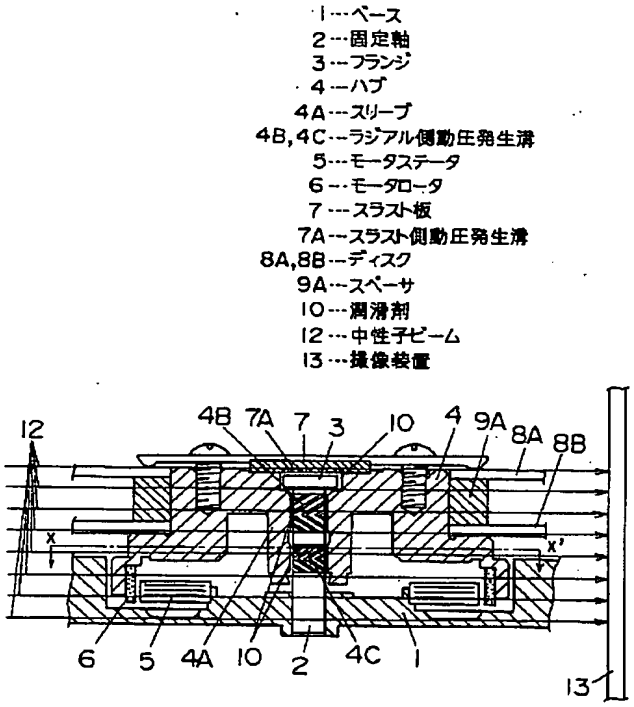
4D, 4E Crevice voluminousness

10 Lubricant

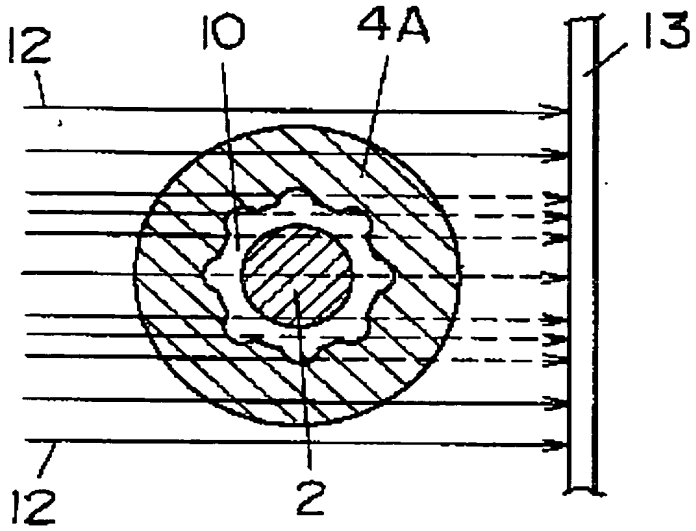
12 Neutron Beam

DRAWINGS

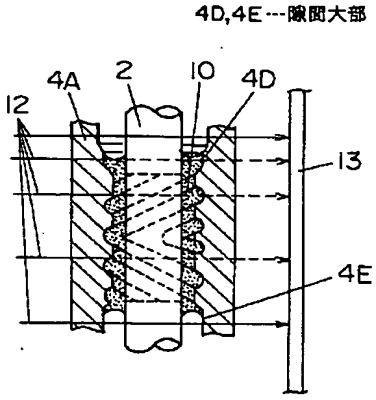
[Drawing 1]



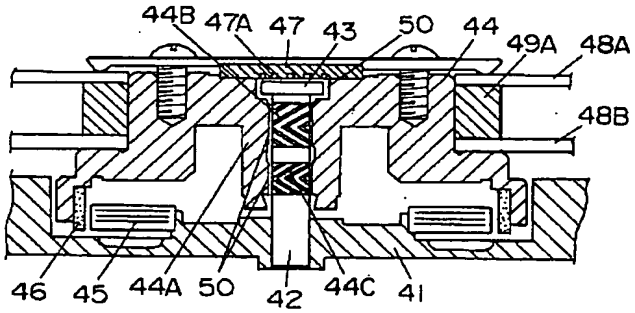
[Drawing 2]



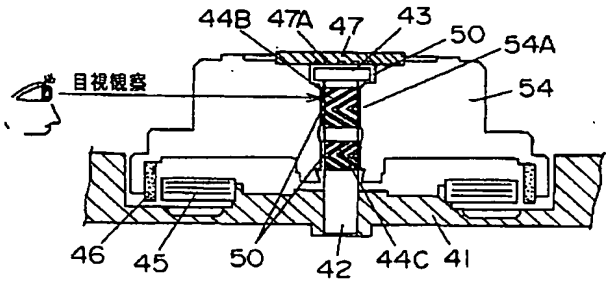
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]